REMARKS

Pending Claims

Claims 1-18 have been rejected under 35 USC §102(e) as being anticipated by Ooba et al. (US 6,084,050). It is respectfully submitted that claims 1-18, as amended, are patentable over Ooba et al. for the reasons set forth below.

Ooba et al. disclose an optical element in Figures 10A and10B, which includes a substrate (33), and a material with a refractive index higher than that of the substrate (32). The refractive index of the material (32) is shown to vary periodically in the direction of light propagation.

New Claim 19 has been added.

Claims 1, 2, 8, 9, and 18

The present invention, as recited in amended claim 1, contains a feature which is neither disclosed, nor suggested by the Ooba et al., namely:

> ... a substrate having a channel for an optical waveguide;...
> (Emphasis Added)

This feature, which is illustrated as element 14 in Figure 1(a), is distinguished from the substrate (element 33 in Figures 10A and 10B) of Ooba et al. Ooba et al. do not include a channel for an optical waveguide in their substrate. The flat, planar shape of the substrate in Ooba et al. is more clearly shown in Figure 3, which is a transparent perspective drawing of the optical element of Ooba et al. The unnumbered, hashed layer on the lower portion of this Figure is the substrate.

Therefore, for the reasons set forth above, claim 1, as amended, is not subject to rejection under 35 USC §102(e) as being anticipated by Ooba et al. As claim 2 is dependent on claim 1, this claim is not subject to this rejection as well. Independent claim 8, as amended, and its dependent claims 9 and 18 include this same feature and, therefore, are not subject to this rejection as well.

Claim 3

The present invention, as recited in claim 3, contains a feature which is neither disclosed, nor suggested by the Ooba et al., namely:

> ... a material which has a refractive index higher than that of said substrate...;
>
> wherein the refractive index in a part of said material varies substantially periodically or is substantially continuously monotone increasing or decreasing in a direction substantially perpendicular to the direction of light propagation. (Emphasis Added)

This feature, which is illustrated in Figures 3(c) and 3(d), is distinguished from the refractive index variation in the material (element 32 in Figures 10A and 10B) of Ooba et al. The refractive index of the material in Ooba et al. varies in the direction of light propagation to form a diffraction grating, but does not similarly vary in the direction perpendicular to the light propagation.

Therefore, for the reasons set forth above, claim 3 is not subject to rejection under 35 USC §102(e) as being anticipated by Ooba et al.

Claims 4 and 5

The present invention, as recited in amended claim 4, contains a feature which is neither disclosed, nor suggested by the Ooba et al., namely:

> ... a resin which has a refractive index higher than that of said substrate...;
>
> wherein the refractive index in a part of said resin varies monotonically in the direction of light propagation and/or in a direction substantially perpendicular to said direction of light propagation. (Emphasis Added)

This feature, which is illustrated in Figures 3(a)-(d), is distinguished from the refractive index variation in the material (element 32 in Figures 10A and 10B) of Ooba et al. The refractive index of the material in Ooba et al. varies periodically in the direction of light propagation to form a diffraction grating, not monotonically in the direction of light propagation or the direction perpendicular to the light propagation, as recited in amended claim 4.

Therefore, for the reasons set forth above, claim 4, as amended, is not subject to rejection under 35 USC §102(e) as being anticipated by Ooba et al. As claim 5 is dependent on claim 4, this claim is not subject to this rejection as well.

Claims 6 and 7

The present invention, as recited in amended claim 6, contains a feature which is neither disclosed, nor suggested by the Ooba et al., namely:

> ... said optical element further includes a plurality of temperature controlling elements disposed on said material and for partially changing the temperature of said material in a direction substantially perpendicular to the direction of light propagation. (Emphasis Added)

This feature, which is disclosed in the Specification on page 21, lines 14-21, is distinguished from the temperature control elements (elements 74 and 75 in Figure 13) of Ooba et al. Ooba et al. disclose a plurality of temperature control elements arranged along the direction of light propagation, but not substantially perpendicular to the direction of light propagation, as recited in amended claim 6.

Claim 7, as amended, recites a plurality of electrodes disposed in a direction substantially perpendicular to the direction of light propagation. Ooba et al. only disclose electrodes as part of heating elements.

Therefore, for the reasons set forth above, claims 6 and 7, as amended, are not subject to rejection under 35 USC §102(e) as being anticipated by Ooba et al.

Claims 10 and 17

Claim 10 depends from any one of claims 1-3 and 6-9 and claim 17 depends from any one of claims 1-7. Therefore, for the reasons set forth above that claims 1-9, as amended, are not subject to rejection under 35 USC §102(e) as being anticipated by Ooba et al., claims 10 and 17 are not subject to this rejection as well.

Claims 11-16

The present invention, as recited in amended claim 11, contains a feature which is neither disclosed, nor suggested by the Ooba et al., namely:

> ... a) forming photo-hardening resin on a substrate;...
> (Emphasis Added)

This feature, which is disclosed in the Specification on page 14, lines 16-21, is distinguished from the thermosetting silicone resin of Ooba et al. Ooba et al. describe their method for forming the grating structure illustrated in their Figures 10A and 10B as follows:

> The core 22 can be formed by using the above-described thermosetting silicone resin, and depicting grating pattern as a refractive index change by 2-beam interference exposure of UV light or phase mask exposure of UV light. (Ooba et al. column 16, lines 31-35)

The resin in Ooba et al. is clearly disclosed as thermosetting, not photo-hardening. Also, the grating structure of Ooba et al. is formed of alternating sections of material having different indices of refraction. Ooba et al. disclose refractive index changes in the waveguide material are based on chemical composition and describe UV lithographic techniques to etch this material.

Therefore, for the reasons set forth above, claim 11, as amended, is not subject to rejection under 35 USC §102(e) as being anticipated by Ooba et al. As claims 12-15 are dependent on claim 11, these claims are not subject to this rejection as well. Independent claim 16, as amended, includes this same feature and, therefore, is not subject to this rejection as well.

Newly Added Claim 19

Newly added claim 19 adds no new matter. Support for this claim may be found in original claim 1. The present invention, as recited in newly added claim 19, contains a feature which is neither disclosed, nor suggested by the Ooba et al., namely:

> ... a material which has a refractive index higher than that of said substrate;
>
> wherein the refractive index in a part of said material is substantially continuously monotone increasing or decreasing in the direction of light propagation. (Emphasis Added)

Therefore, consideration and allowance of newly added claim 19 is requested.

CONCLUSION

Based on the foregoing amendment and remarks, Applicants respectfully submit that claims 1-18, as amended, and newly added claim 19 are in condition for allowance. Accordingly, reconsideration and allowance of all pending claims are respectfully requested.

Respectfully submitted,

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LC/ds

Enclosure: Version With Markings Showing Changes Made

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March 21, 2003

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claim 19 has been newly added.

1. (Amended) An optical element comprising~~:~~:

a substrate having ~~or not having~~ a channel for an optical waveguide; ~~and~~ and

a material which has a refractive index higher than that of said substrate and is filled in said channel for optical waveguide or is disposed on said substrate~~;~~;

wherein the refractive index in a part of said material varies substantially periodically or is substantially continuously monotone increasing or decreasing in the direction of light propagation.

4. (Amended) An optical element comprising~~:~~:

a substrate having or not having a channel for an optical waveguide; ~~and~~ and

a resin which has a refractive index higher than that of said substrate and is filled in said channel for optical waveguide or is disposed on said substrate~~;~~;

wherein the refractive index in a part of said resin varies monotonically in the direction of light propagation and/or in a direction substantially perpendicular to said direction of light propagation.

6. (Amended) An optical element comprising~~:~~:

a substrate having or not having a channel for an optical waveguide; ~~and~~ and

a material which has a refractive index higher than that of said substrate and is filled in said channel for optical waveguide or is disposed on said substrate~~;~~;

wherein said optical element further ~~comprises~~ includes a plurality of temperature controlling elements disposed on said material and for partially changing the

temperature of said material in ~~the direction of light propagation and/or in~~ a direction substantially perpendicular to ~~said~~ the direction of light propagation.

7. (Amended) An optical element comprising~~:~~ :

a substrate having or not having a channel for an optical waveguide; ~~and~~ and

a material which has a refractive index higher than that of said substrate and is filled in said channel for optical waveguide or is disposed on said substrate~~;~~ ;

wherein said optical element further ~~comprises~~ includes a plurality of electrodes disposed on said material and for partially changing the electric field in said material in the direction of light propagation and/or in a direction substantially perpendicular to said direction of light propagation.

8. (Amended) An optical element comprising~~:~~ :

a substrate having ~~or not having~~ a channel for an optical waveguide; ~~and~~ and

a material which has a refractive index higher than that of said substrate and is filled in said channel for optical waveguide or is disposed on said substrate~~;~~ ;

wherein said optical element further comprises a part where said material protrudes to the direction of said substrate and/or a part where said substrate protrudes to the direction of said material, in the direction of light propagation and/or in a direction substantially perpendicular to ~~said~~ the direction of light propagation.

11. (Amended) ~~In a~~ A method of fabrication of an optical element ~~wherein~~ comprising the steps of:

a) forming photo-hardening resin ~~is formed in~~on a substrate~~,~~ ; and ~~wherein~~

b) irradiating light ~~is irradiated~~ onto said photo-hardening resin, thereby hardening said photo-hardening resin ~~a method of fabrication of optical element~~ ;

wherein the amount of said light ~~irradiated onto the surface of said photo-hardening resin~~irradiation in step (b) is varied.

12. (Amended) A method of fabrication of an optical element according to Claim 11, wherein the amount of said light irradiation in step (b) is varied substantially

periodically or is substantially continuously monotone increasing or decreasing, in a predetermined direction on the surface of said photo-hardening resin.

13. (Amended) A method of fabrication of an optical element according to Claim 11 or 12, wherein the intensity of said light irradiation onto said photo-hardening resin in step (b) is varied, whereby the amount of said light irradiation onto the surface of said photo-hardening resin is varied.

14. (Amended) A method of fabrication of an optical element according to Claim 13, wherein a mask having partially different light transmissivity is used, whereby the intensity of said light irradiation onto the surface of said photo-hardening resin in step (b) is varied.

15. (Amended) A method of fabrication of an optical element according to Claim 11 or 12, wherein a light shielding plate is used so as to sequentially change the region irradiated by said light, whereby the amount of said light irradiation onto said photo-hardening resin in step (b) is varied.

16. (Amended) ~~In a~~A method of fabrication of an optical element~~, wherein~~ comprising the steps of:

a) forming photo-hardening resin ~~is formed in~~on a substrate~~, and wherein~~;

b) connecting an optical component to said photo-hardening resin; and

c) irradiating light ~~is irradiated~~ onto said photo-hardening resin, thereby hardening said photo-hardening resin~~, a method of fabrication of optical element,~~;

~~-~~wherein ~~another optical component is connected to said photo-hardening resin, and then said photo-hardening resin is hardened, whereby~~ said optical component is fixed to said photo-hardening resin when said photo-hardening resin is hardened in step (c).